PROCEDURE FOR TAKING SOIL SAMPLES

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TABLE OF CONTENTS

Page

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1. INTRODUCTION

The accuracy of soil analysis depends upon proper care in securing and handling of a sample. Therefore, collecting a sample is the most important step in soil testing. The importance of proper sampling lies in the fact that errors made in collection of the sample cannot be detected or corrected. However, at times it might be possible to detect this when the results of soil analysis do not seem to agree with the plant symptoms observed--and it would be too late then. On the other hand, errors that may have occurred in the laboratory when the samples are being analysed can be detected by an experienced soil analyst since many soil properties show a close interdependence. Therefore, it will merely be a waste of time and money if analysis is carried out on samples that have not been collected and handled properly. "It is wasteful to use laboratory facilities and time on poorly collected soil samples or those without adequate descriptions and names."*

Sampling technique and care during sampling will depend partly on the purpose of the analysis, i.e. soil fertility evaluation or soil classification and mapping. Soil Survey Groups are interested in collecting samples of genetic horizons while Soil Fertility Groups are interested mainly in sampling soil from arbitrary depths.

It must be pointed out here that for many projects all the analyses mentioned in Section 7 (which are particularly useful for soil fertility evaluation) are not required. Therefore, only a part of these analyses would be done if the soil sampler has so indicated. It is suggested that the sampler should contact Soils Laboratory, if necessary, for advice as to which analyses may be required for his particular project. In addition to the Routine Soil Analysis (Section 7) extensive and laborious analyses for specific purposes can be performed in Soils Laboratory depending upon the objective of the project concerned.

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* Soil Survey Manual, U.S.D.A. Hdbk. No. 18, 1951, p. 327.

2. EQUIPMENT NEEDED

2.1 SAMPLING TOOL

The sampling tool should provide a sample of uniform cross-section throughout the sampling depth.

2.1.1. Soil sampling auger and probe

When individual samples are to be collected, use an auger or probe only to explore the soil to find variation in the field (both vertical and horizontal) and thus select a suitable location for sampling. Sampling must not be done by augers or probes if individual samples are to be collected for soil classification purposes.

When the soil samples are collected for fertility evaluation, e.g. for nurseries, a soil auger or soil tube may be used, particularly when sampling subsurface soils. Use a soil tube or barrel-type auger for a small or large sample, respectively. Augers are particularly useful for sampling heavy soils. However, one problem that arises in using the common soil auger is that the soil from upper depths may contaminate the soil sampled from the lower horizons. The core- or post-type augers are generally better than the screw- or worm-type soil augers, the former being useful in dry regions and the latter is good in wet regions. Put permanent scale marks on the shaft of the auger from the tip to find horizon depth. For some purposes the auger is superior and faster than the spade. However, soil structure is destroyed if the auger is used--especially the screw-type auger. Sampling tubes are well adapted for sampling moist, medium-textured, nonstony soils. The limitation with the samples taken with tube is that supplementary observations of the undisturbed soils cannot be taken. At the same time, they are difficult to use in dry, stony, clayey or very sandy soils. The soil tube or auger should be inserted in the soil to the desired depth and the core of soil thus removed should be collected.

2.1.2. Spade

It is used to dig a soil pit--a must when collecting samples for soil survey purposes. Samples of surface soils, in soil fertility evaluation, can conveniently be taken with a round-point trenching spade which is especially convenient for stony, dry, clayey soils.

2.1.3. Peat Sampler

A specially designed peat sampler should be used to collect peat or marl samples from beneath the water table. Surface samples can be safely collected by trenching into the peat and sampling from the desired stratum.

2.2 OTHER TOOLS

2.2.1. Trowel or large knife

Trowel or large knife, e.g. hunting knife, bayonet, etc. is used to clean and smoothen the wall of the pit.

2.2.2. Pick

A small steel pick is useful for examining the soil profile (4.2.4.).

2.2.3. Scoop

It is used to fill sample bags. A trowel may also be used for this purpose.

2.3 CONTAINERS

Plastic bags should be used for collecting moist soil. However, cardboard cartons can also be used if the samples are not too moist. It is much more convenient to carry plastic bags to the field than the cartons. Moreover, moist samples will damage the carton. Therefore, it is preferable to use a plastic bag. Moist samples should not be placed in paper bags.

2.4 IDENTIFICATION TAGS

They are used to supply information required in Section 5.

3. SELECTION OF METHOD OF SAMPLING

Individual samples may be retained separately or samples may be composited depending upon the purpose for which the soil samples are required.

3.1 INDIVIDUAL SAMPLES

Samples should not be composited if analysis of a specific spot is required. Samples from different pits must be analyzed separately if the object of the study is to establish an estimate of variability of the nutrient level or some other properties of soil in a particular plot. It must be pointed out here that individual samples have little or no value for the evaluation of soil fertility status of a soil, e.g. nursery block.

3.2 COMPOSITE SAMPLES

A bulk sample can be prepared by pooling the soil from different spots and then analyzing a subsample which will give a representative analysis of the given area. Composite sampling is essential when the soil is being analyzed to estimate the portential fertility of soils. Analysis of a composite sample will give an estimate of the mean nutrient status. Composite samples have little value for soil survey work where emphasis is given for analyzing individual samples to study the genetic nature of soils.

4. PROCEDURE

The points described below or some modification of them to meet individual needs, in general, would help in obtaining a good soil sample and its subsequent handling.

4.1 PRECAUTIONS

4.1.1. Seasonal changes

Soil properties such as pH, available phosphorus, and available potassium levels show variation with the season. Therefore, seasonal variation should be taken into consideration when interpreting soil test results, particularly in long term experiments.

4.1.2. Surface layer of organic material

Since forest soils usually have a well established layer of organic material on the surface, all organic material not incorporated with soil should be scraped away or collected separately from the rest of the soil before a sample is taken. It must be remembered at this point that with some trees, e.g. fir, spruce, etc., most of the fine feeding roots are in this humus layer and, therefore, it should be analyzed separately since in these cases this layer supplies a major part of the nutrients absorbed by trees.

4.1.3. Avoid contamination

Great care must be exercised to avoid contamination of the sample with other soil, fertilizer, manure, crop residue, or any other foreign material.

4.1.4. Sample all layers of the profile separately

Do not mix soil from different horizons or depths since soils vary both horizontally and vertically.

4.1.5. Remove foreign material

Remove roots, leaves, stones, large gravel and any other foreign material. However, do not discard gravel from highly gravelly soil because finer particles are often deposited on the gravel. Do not remove stone or gravel if their weight is required.

4.1.6. Take a large enough sample

The size of the sample for submission will depend on the number and type of analyses required. Submit about <u>one quart</u> soil so that analyses may be carried out and whenever desired, alternative procedures may be used to compare methods of analysis and also to run duplicate analyses. Also, sometimes it may be desirable to use the remainder of the soil to try new methods or to standardize some procedure if some soil has been found to have some interesting characteristics.

4.2 TAKING AN INDIVIDUAL SAMPLE

4.2.1. Fresh excavation

Always take a sample from a fresh excavation made through the soil and into the parent material. Do not take samples from road cuts or old excavations without exposing a fresh face.

4.2.2. Expose a profile

After the site has been chosen, dig a rectangular pit with a round mouth spade since using auger may create error due to rodent holes or other unconformities that cannot be seen. The pit should be deep enough to expose the parent material.

4.2.3. Clean the best lighted wall

One wall of the pit should be cleaned and smoothed with a trowel or large knife, e.g. hunting knife, bayonet, etc. The wall which is cleaned must be uniformly lighted by sun so that different horizons can be easily examined.

4.2.4. Description of the profile

Describe the soil profile by marking off the recognizable horizons and writing down the depth of each horizon and all other visible characteristics. Each horizon may be subdivided if more detailed information is required. Zones of transition are found between adjacent horizons in many profiles.

4.2.5. Sampling

Once the width of a horizon has been determined, take a sample several inches in depth near the centre of the horizon without attempting to collect sample from the whole depth of the horizon.

4.2.6. Before leaving the sampling site

After observation and taking soil sample, the pit should be filled with the soil and tamped down.

4.3 TAKING A COMPOSITE SAMPLE

4.3.1. Heterogeneity of the area

Divide the area into different sampling areas depending upon visual inspection of differences in soil type, their parent material, micro-relief, texture, color, i.e. light colored separate from dark colored, surface drainage, proximity to trees, degree of erosion, plant growth, land use, vegetation, past management e.g. fertilization, etc., topographic location, ground cover, genetic features and any other distinct visual variations. Each homogenous area should be sampled and analyzed separately.

4.3.2. Unusual spots

Sample only uniform areas and when it is difficult to select a homogeneous area select as nearly uniform area as possible. Disregard (or sample separately, if dominant and if the sampler is especially interested) any unusual spots such as low spots, saline or other unusual areas, knolls, terrace channels, wet spots, swampy areas, areas near lime-rock roads, areas near the boundary between slopes and bottomland and areas along fertilizer bands, windbreaks, shelterbelts, snow fence, and old fence line. Samples from high spots and low spots should never be mixed together in an effort to obtain a representative sample of the two spots. If the whole field is to be fertilized as a unit, then no attempt should be made to divide the field for sampling but the problem spots should be left out.

4.3.3. Depth of sample

What depth should be taken would depend on the purpose of the experiment. Soil samples for trees must include more than just top 0-6" depth. Several arbitrary depths, e.g. 0-6", 6-12" and 12-24" are taken for fertility evaluation (0-6" for nursery soils).

4.3.4. Selection of sampling points

The location of a point for boring should be selected. "Random method" consists of selecting the points by complete randomization and should not have a personal bias. In the "stratified random method" the points are allocated equally to several strata and then some points are selected at random within strata. A random starting point is taken to place the grid in "random grid method" and the samples are taken at the intersections of grid lines. For the "zig-zag pattern" a random starting point is taken and the samples are collected uniformly along the zig-zag path.

4.3.5. Comparison of plots

If a number of plots of the same size and different treatments are being compared for fertility evaluation, e.g. nurseries, etc., it is essential that the same number of cores should be taken from all the plots and the samples from one plot should not be mixed with the samples from other plots.

4.3.6. Number of sampling sites

Generally 10-15 cores should be taken from an acre of land. The number and spacings of borings that would make up a composite sample would depend on the size of the area, magnitude of variability, degree of accuracy required, and the purpose of the analysis. More sites should be selected for cultivated soils than virgin soils. More sites should be selected for saline and alkali soils than for normal soils.

4.3.7. Volume basis

Take uniform volumes of the soil from each core. Do not mix samples of unlike horizons.

4.3.8. Composite sample

Collect the samples in a clean pail or other suitable container. All samples should have the same color and texture. Break the clods and thoroughly mix the samples of the same horizon collected from different parts of the area to form one composite or bulk sample. Take about a quart of the soil.

5. IDENTIFICATION OF SAMPLES

Place the sample in the plastic bag and tie the identification tag around the neck. Supply identification information as indicated on the tag. Identification tags for soil samples submitted to the Soils Laboratory should contain information in the following order: name of the soil sampler, year of sampling (or date) and sample number and horizon designation or depth. (Tags are available from Soils Laboratory.)

Or use abbreviation to form a three-part symbol: Part 1--the name of the sampler, Part 2--last two digits of the year when the sample was collected, and Part 3--a number designating the number of the soil sample, and horizon designation or depth, e.g. Zoltai-68-1 Bt. A laboratory number will be assigned to each sample submitted. In case a carton, e.g. one quart ice cream carton, is used, place an identification tag in it. Since in this case the tag in the carton comes in contact with soil, information on the tag may not remain in a readable condition if soil is moist. Therefore, in addition to placing a tag in the carton, the information should be written on the carton. It is suggested that the bag of moist soil should be placed in another plastic bag and the tag be placed between these two bags, to protect the tag from becoming moist. An identification tag should be tied around the neck of the bag. To avoid confusion, label the samples as soon as they have been collected. Send the samples to the Soils Laboratory for drying and subsequent handling of the samples. Complete a "Request for Soil Analysis" form (Appendix 1).

For the interpretation of results it is very important that you keep an accurate record of the exact areas sampled. Familiarize yourself with the soils, vegetation, cultural practices and history. An idea of the general growth and vigor of a stand of trees will be helpful in the interpretation of the soil tests. Site and profile description of the soils sampled is necessary for the interpretation of the results obtained in the Soils Laboratory. For the interpretation of the analytical information it should be pointed out that a soil test gives the fertility status of a

soil but fertility is only a part of the productivity which is not an inherent quality of the soil. Besides the fertility status, other factors such as drainage conditions, past management, e.g. fertilization, etc., climatic conditions, erosion, etc. must be taken into consideration for the interpretation and making a recommendation. Soil productivity is the resultant of a multitude of factors--soil fertility being one of them.

6. SUBMISSION OF SAMPLES DELAYED IN THE FIELD

The samples should be sent to the Soils Laboratory as soon as possible after they have been collected. If the samples cannot be sent to the Soils Laboratory for air-drying, spread out the soil to dry in a thin layer on a clean wooden tray or a clean sheet of strong wrapping paper or wax paper for about two days in a sunny place or a room ensuring that it is not contaminated by dust or fumes. Dry the samples as soon as possible after they have been collected because on storing a moist soil, changes in the chemical status of some ions, e.g. NO_3, organic matter, etc. may occur. Do not use oven to hasten drying. Break the soil clods when the soil is moist and also during the air-drying process when it is at a favourable moisture content. This is very important particularly in case of clayey soils. Breaking the clods will help in the subsequent process of drying, mixing, and subsampling. Clay soils are very difficult to grind once they have dried and therefore, the soil lumps must be broken when the samples are air-drying. Air-dried soils can be stored for reasonably long periods without any significant chemical changes.

7. ROUTINE SOIL ANALYSIS

The soils will be air-dried and ground by a mechanical soil grinding mill and sieved in the laboratory for final analysis.

Usually, as a routine analysis, soil samples will be analyzed for the following characteristics (please see Section 1).

Texture; presence or absence of free carbonates; degree of acidity or alkalinity (pH); amounts of soluble salts (conductivity) and qualitative tests for soluble salts if conductivity is greater than 4 mmhos/cm; organic matter; available and/or total nitrogen (N); available phosphorus (P); exchangeable potassium (K), and cation exchange capacity.

8. DISPOSAL OF SAMPLES

After soil analysis, the samples will be discarded unless requested otherwise.

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APPENDIX 1. REQUEST FOR SOIL ANALYSIS*

Research Scientist _____

Project _____

Please do not write in this space.

Lab No. From_____To_____

Job No. _____

Have the samples been air-dried? Yes _____ No _____

Samples submitted to the Soils Laboratory on (Date) _____

Results of analysis needed on (Date) _____

Total number of samples submitted _____

Types of analyses required:

* Copies of this form are available from Soils Laboratory.